



## Qualifying the quantified self - A study of conscious learning

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## Qualifying the quantified self - A study of conscious learning

**Abstract:** Smartphones are used by 63% of the college students in this study to create consciousness about how much they exercise, how many calories they eat, how well they sleep and how their mood is. But only 4% use smartphones to raise awareness about how they learn and how much they learn. None the less, 65% of the college students in this study think that such usage might be fruitful. This paper examines how we can use smartphones and the notion of the 'quantified self' to both quantify and qualify a learning process. The authors argue that increased consciousness about one's own learning process will impart more robust study skills and higher level of learning competence and that learners thereby will utilize networks and personal technology in a more fruitful manner. The study questions if quantification in itself will create consciousness and it also questions the idea that; the more we measure and document, the more knowledge we obtain about the object we measure. The authors claim that, though the measurement reifies itself in statistics and graphs, it might not create consciousness and change in behavior. In this perspective the quantification is a kind of 'pseudo-reification' that needs qualification to contribute to the individual's knowledge production process. The paper's main focus is on the qualification of the quantified data. In other words there is a need for new, more creative ways of combining smartphones, study skills and learning. This paper presents an experiment that utilizes the multipurpose, mobile, connected convenience of a smartphone and the 'Edmodo' and 'Twitter' app in a quest for conscious competence learning in a rhizomatic learning environment in further education. The study is based on a quantitative survey, observation of teaching and qualitative interviews. We found that even though the students already use 'quantified self' apps in their personal lives, they were not necessarily inspired to take the principles of the quantified self to their own learning process. We also found that those who do take these principles and make them part of their personal learning environment (PLE) feel that they gain more consciousness from this process. So the question is can smartphones be utilized as vehicle for conscious competence learning (Burch 1970)?

We found that the students generally regard learning as a personal develop in an intimate relationship with a mentor, trusted peer or teacher, hence it is a rather big change to implement an open-source based learning stream. We found that there is a great difference between posting exercise results and learning progression. None the less we believe that in the right pedagogical circumstances the open-source learning stream can be a fruitful way of utilizing mobile technology in a learning process.

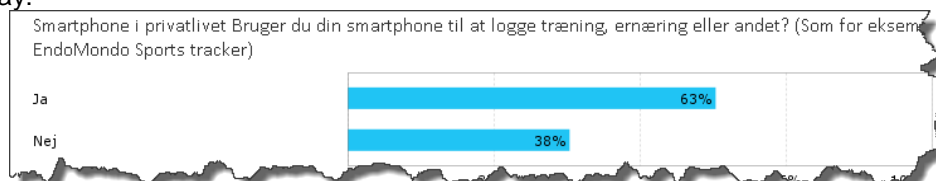
**Keywords:** Mobile learning, Personal learning environment, rhizomatic learning, smartphones, conscious learning, 'open source learning stream'.

### 1.0 Introduction

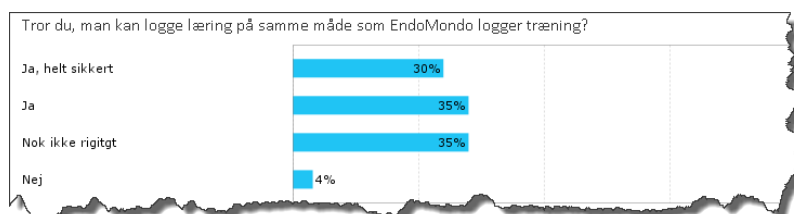
If we assume that 'the quantified self' is a more conscious self than the 'unquantified self', then it would be interesting to take the quantification of the self into the field of learning. This paper describes a small study carried out at a teachers' college (UCN Aalborg, Denmark) where students were asked to take the quantification principles of exercise tracking, nutrition tracking, mood tracking etc. and use these principles in their own learning process. The aim of the experiment was to find out whether these principles would work in learning processes and whether the students would include these principles in their personal learning environment. The aim was also to create a qualifying process that would take the personal, quantified data and turn it into more social 'open source' experience (Larsen 2009). The study uses the notion of the rhizome (Deleuze & Guattari 2007) as a metaphor for information exchange and peer interaction (de Freitas 2012). We use the metaphor to describe the complexity of 'information travel' and interaction in a technology rich learning environment. To follow Wenger's idea of placing learning in the center of "*...our lived experience of participation in the world*" (Wenger 1999), this study tries to utilize the technology that is now, arguably, in the center of *our lived experience of participation in the world*: the smartphone. Personal mobile technology is a dominating part of youth's interaction with the virtual world and with peers (Rheingold 2012) but it does not seem to be a dominating part of their formal learning process. We use personal technology to track; exercise, sleep pattern, intake of calories, communication (SMS, phone, email, social networks etc.). We can document and communicate our experiences through posting of photos, videos and micro-blogging in social networks. We can trace progression in our exercise if we leaf through the statistics in our exercise app, we can trace the reason for our mood swings in our 'How did you sleep' app etc.

(Høeg Niessen 2013). We can integrate the documentation for our actions in a social network as a part of our 'open source identity' (Larsen 2009).

In a small study of student's involvement in 'quantified self' activity, the respondents replied in the following way:



**Figure 1:** Question: Do you use your smartphone for logging exercise, nutrition, sleep, mood ect? Answers: Yes 63%, no 38%



**Figure 2:** Question: Do you think that you can log learning like you log exercise? Answers: Yes definitely: 30%, yes, 35%, No probably not 35%, No 4%

When 63% already use their smartphone for 'quantified self' purposes and 65% regard using the smartphone for learning tracking as a plausible possibility, the path for taking the quantitative usage of the smartphone in a more qualitative direction should be laid down. So, for the small population of the study, the idea of using the smartphone as a tool for collecting quantitative data about personal activities is not regarded as exotic. The 'quantified self' is driven by a lot of things; it is convenient, it synthesizes different data from different sources, it seems to report 'truthfully' from otherwise immanent and invisible processes and 'quantified self' data is sharable in social media. So the 'quantified self' seems to give us insight into new undiscovered areas of the self. The quantified self is a growing movement and new areas to quantify are frequently added to list of factors of life we can measure. None the less, learning is not one of the. At the QS13 (Quantified Self Conference in San Francisco, October 10-11 2013) there did not seem to be presentations of actual learning tracking. So there is a tendency to track what can be registered as 'either/or' and otherwise quantified in numbers. In this study, we tried to take the quantification to a more organic level, where the quantification itself was more an input to the learner's memory for later social acknowledgment.

## 2.0 From pseudo reification to conscious learning

This aforementioned 'social acknowledgement' is seen as a participation in a common learning process that is reified as input (text, images, sound or video) on a smartphone shared on a web 2.0 website (Twitter, Edmodo etc.). The study's theoretical point of departure is the notion of participation and reification (Wenger 1999) in a community of practice. In this approach to learning, it is assumed that learners gain experience through participation and that learning is materialized through reification. In a successful learning context, we have a common repertoire with a specific protocol and concord of actions. A common repertoire also includes a common set of technologies, communication network and types of products. Learner behavior in a fully integrated community of practice is often unconscious and thus unreflected (because it is an acquired culture that is a learning habitat for that given community of practice)(Wenger, White & Smith 2009). Furthermore, the community of practice makes a shift in paradigm from institutionalized teaching to personal learning:

*So, what if we adopt a different perspective, one that placed learning in the context of our lived experience of participation in the world? What if we assumed that learning is as much a part of our human nature as eating or sleeping that is both life-sustaining and inevitable, and that - given a chance - we are quite good at it?*  
(Wenger 1999)

This means that pedagogical designs should take their point of departure in the student's lived experience and participation with his/her peers, subjects, technology, etc. That is exactly what the smartphone does in many students' private lives. The smartphone connects with peers and lets the student report from his/her life to his/her network. So if we place the smartphone in the center of the student's learning process, we might utilize the potential of the network.

Furthermore, if attending teaching sessions is unconscious and unreflected, then it could be claimed to be almost ritual. The ritual-like activities might make the learners more comfortable in a teaching situation, but it might also be a hindrance for empowering the learner to reach a level of 'self programmableness' (Castells 2005) or autopoiesis (Kay 2007, Luhmann 1995), in the sense that the learner and the learning context is a autopoietic system (Luhmann 1995). Awareness of how and when the learner acknowledges new knowledge, that is, when the learner processes information and experience to form new knowledge, might empower the learner to acquire new knowledge on the basis of his/her own devices. Our general assumption is that the quantified self does not automatically create increased awareness or a more qualified self. Maybe it does, in fact, generate the illusion of gaining a more conscious process while dulling the actual awareness level (Hoeg-Nissen 2013). The notion of 'better living through the quantified self' is nurtured by the idea that big data generally is a benevolent, philanthropic movement that helps post-modern individuals overcome a hyper complex everyday life (Høeg Nissen 2013). The quantified self could also be seen as a way of externalizing basic human consciousness. Good, helpful tools start out as relief from trivial everyday hassles such as; finding one's way, spelling correctly, mental arithmetic, remembering phone numbers, keeping track of calendar appointments. But they might end up affecting our ability to understand spatiality, our ability to remember and our ability to act on instinct (Carr 2010). The quantified self is a kind of reification of personal experience in numbers but without participation and without any actual 'building-process'. So in that sense it is 'pseudo reification'. In order to assign value to the reification – to lift it from a pseudo state to a 'real' state – this study tries to embed the quantified self data-growing into a pedagogic design where the quantified self data becomes social. The study tries to follow the hypothesis that if a student is already using his/her phone for quantified self tracking (exercise, nutrition, mood, etc.) then the student would be more prone to use his/her smartphone for learning tracking.

### **3.0 Theoretical approach – the 'open source learning stream'.**

This study is inspired by the slogan: "I store my knowledge in my friends" (Stephenson 1997), a statement that emphasizes the alleged importance of peers in the learning process. The network could be said to prolong the learner's knowledge sphere and in this line of thinking the size of a learner's knowledge sphere is depending on the learner's ability to master learning in networks. This study tries to synthesize the sociality of sharing and the cognitive solitude of realizing. When the student tracks 'learning events' he/she is starting an individual, cognitive process that might help the student remember something or might trigger a deeper acknowledgement. But when that tracking is shared, it becomes both personal and public and if another student tabs on to the learning-stream and contributes to it, the learning stream becomes a common process. So the idea behind the study is to create first a private, then a public learning stream. That would make it a co-created 'open source learning stream'. The 'open source learning stream' should be a vital part of the common repertoire in the community of practice brought on by the convenience of the technology at hand (Sorensen, E. K. 2010). The 'open source learning stream' is unmanaged: it follows the unorganized pattern of a rhizomatic network. The rhizome is used as a metaphor for how information travels in a virtual network (Kjærgaard & Sorensen 2014). The rhizome metaphor was first used in 'A thousand Plateaus' (Deleuze & Guattari 1987), where the rhizome was described as follows: "The rhizome is altogether different, a map and not a tracing. Make a map, not a tracing" (Deleuze & Guattari 1987). If this metaphor is applied to the notion of the 'open source learning stream', it would suggest that teaching should not present a given path from 'a' to 'b' but a map of possibilities within the subject matter. This map of the possible learning paths would open more ways to carry out the task than one. The map would include more learners in the common activities in the classroom because the learners themselves would co-design the activities in the classroom.

#### **4.0 Epistemology – how is knowledge about ‘Open source learning streams’ possible?**

The scope of this study was to investigate if conscious learning could be catalyzed by tracking learning events in quantified self apps. In order to gain knowledge about that, we chose to use a critical realist approach (Bhaskar 2008). Critical realism was developed to combine empiricism and idealism as a hybrid approach to science (social science) (Kjærgaard & Sørensen 2014). In that sense critical realism joins ontology and epistemology. It is believed that reality consists of an intransitive level that is real and a transitive level that is part real and part socially constructed (Wikgren 2004). This duality of intransitive and transitive levels makes it possible to use critical realism to analyze a situation for what is given and what is socially constructed. The researcher is able to make a meaningful hypothesis on the basis of structures, mechanisms, actors and positions defining the circumstance under which the learning situation in question exists. These structures hold mechanisms that affect the emergence of a new synthesized entity.

Critical realism is used in this study because:

- It demands of the researcher to look beyond mono-causalities
- It demands of researchers to acknowledge intransitive, given factors
- It demands of researchers to combine ontology and epistemology, to give a view of what is real and what is socially constructed reality.
- It does not give prescriptive ‘best practices’. Instead it gives insight into one specific instance and this specific instance’s tendency to do certain things.
- It does not operate with the notion of an objective truth but on the other hand it does not reduce everything to social constructions either. It leaves a window open for the researcher to gain insight into the object in question.
- It opens for analysis of ‘emergence’ of a synthesized entity that only comes to existence due to circumstances in the underlying layers (structures, mechanisms, actors and positions)

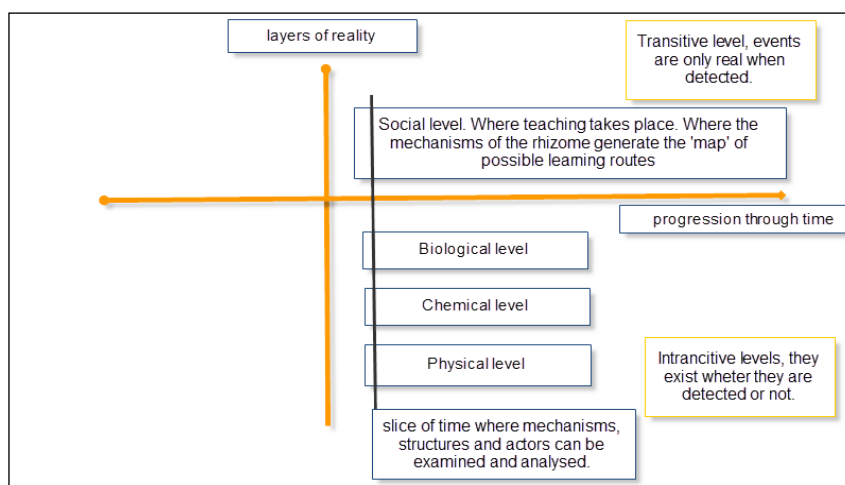
Applied to this study, that means we believe that we can analyze the pedagogical design and gain understanding of the complex circumstances under which the teaching takes place. The aim is to expose representations of underlying structures, mechanisms, actors and positions that make the learning experience happen (or not happen).

#### **4.1 Retroduction and abduction – knowledge detective**

In this study, we have used a retroductive and abductive approach to reasoning. The retroductive approach relies on the researcher’s ability to make insightful interpretations and on the basis of that to make meaningful hypotheses and interventions (Bhaskar 1979). The approaches are chosen because this study is exploring new territory. The exploration is designed on the basis of our own knowledge and the meaningful abductions we can make from that. As detectives we seek a hypothesis that is worth investigating, not necessarily one that is thought to prove true in advance (Achinstein 1991). As critical realists we may apply a retroductive approach which means that a situation (open source learning stream) is predicted by identification of the mechanisms (smartphones, apps) that might produce the situation (Sayer 1992) but the quality of the retroduction is depending heavily on our knowledge of the students, curriculum etc. (and our methodological competence). In this study, we utilize the interplay between analysis of observed teaching and retroductive design of new teaching. We look for mechanisms, structures and positions that create the foundation for the actors to learn on the social level. We started out by thinking that there might be something interesting to approaching ‘the quantified self movement’ from a teacher’s perspective and apply it to a learning context. Quantification of a learning process might give students new insight to how they learn. On the basis of our experience we made a line of questions; how could the principles of ‘the Quantified Self’ be utilized in teaching? How could it be social? And could it turn into an ‘open source learning stream’? Then we learned as much as possible about what quantification of the self is and to what extent our students already know about it. Then we made a pedagogical design that utilized the parts of ‘The Quantified Self’ that we thought would be fruitful.

## 4.2 Analytical approach – the ‘slice of time analysis’

The study was carried out by analyzing a selection of pedagogic designs using a model made from partly the description of the rhizome and partly from the description of critical realism. We have called the model for ‘slice of time analysis model’ and it could be shown in a matrix (unpublished Kjærgaard 2013):



**Figure 3:** Graphic display of the ‘slice of time analysis’

The ‘Slice of time analysis’ is used as a point of entry for a thick description of what happens at a given time in the situation. In the thick description, we look for representations of mechanisms at play, and which actors are active, what structures are visible and, most importantly, we look for the emergence of mechanisms that create ‘new thirds’. The ‘new third’ is really what we are looking for: that constellation of mechanisms that generate something unforeseen, something that redefines our actions in a teaching situation or in a learning process (depending on view).

## 5.0 Application to teaching

The study was carried out both in whole classes and on individual students. One class was a freshman class at the teachers’ college at UCN Aalborg, Denmark. The other was a course for teachers at Act2Learn, UCN Aalborg, Denmark. The individual students signed up for the experiment through our survey. The students were asked to post a comment/note on their smartphone whenever something happened that affected their learning. That could be when they encountered a word they didn’t understand, saw a new relation between theory and practice, when they realized something new, when they encountered difficulties, etc.

### 5.1 Application to course 1: Year one course at teachers’ college.

The technological and theoretical framework described above was used in a course on a small scale. The students were told to create Twitter and ‘Edmodo’ accounts. They were told to name the account in a way that would signal that it was for educational use to prevent unsuspecting followers. They were told to install the twitter app on their phone and to use hashtag ‘#Learningtrackning’. Their assignment was to tweet whenever they experienced anything new related to their learning process. It could be a new word, a new acknowledgement or just something regarding the learning process they would like to remember. Google spreadsheet and TAGS script (TAGS v5) was used to harvest the students’ tweets. After growing and harvesting the data, we used the data as a point of departure for individual talks with the students about their learning progression. The awareness level that the tweets represented was worth something in the guidance talk, it pointed out the direction in which the student had progressed. The next step was to make the students follow each other on Twitter, so that one student’s awareness became input to trigger another student’s wondering. The individual learning process started with an initial experience and a pseudo-reification through Twitter. After that, the process was opened up to the learning community (the class) and then it became a cooperative process, where everybody became aware of everybody’s learning process. The quantified self technique became a shared repertoire in the learning environment. We assumed

that because a lot of the students already participated in 'quantified self activities' it would be easy to implement quantified self ideas on learning. But it turned out that the ones who didn't use tracker apps were more prone to follow the idea of using the smartphone as a learning tracking device. After the Twitter experiment we tried the same with 'Edmodo' (free LMS with app). Edmodo proved to be the better choice for technology. The app was better and the refresh-rates were much better, which meant that the real-time sharing of learning input in the 'open source learning stream' went more smoothly. The experiment also introduced new positions for the students. They were now both receivers and producers of learning content. The students had to get used to both let other students in on their learning process and contribute to other students learning process. The tweets were representations of the student's learning process and it might give insight to the student's progression and furthermore how guidance from the teacher could help the student's learning process (Walker, Lyndon 2012).

### **5.2 Application to individual students**

The principles of 'the quantified self' were also applied to individual students. In this case the process remained private until it was used in a guidance talks between student and teacher. The students approached the experiment differently. Two students were used to tracking exercise and thought it would be easy to apply the same principles to learning. One student didn't use her smartphone for exercise tracking but she already used it for keeping track with her learning process. She said:

*'I don't use Endomondo or any other tracking app but I take notes on my smartphones. I log everything I'm afraid that I would forget. I log any process that I'm part of so that I can learn from it'* (Student)

The student is basically using her smartphone to make process-portfolio. We have worked with portfolios for many years and we have never really made it work. We often split the portfolio into a process-portfolio and a presentation-portfolio. The idea is great, the didactic designs were great and we always get great presentation-portfolios, but to the students the process-portfolio always seemed like another hand-in. We have never succeeded in creating the structures, mechanisms and positions to catalyze the process-portfolio. Excuses are many; the LMS that we used was complicated, the students were not used to reflecting on their own learning process, the students wanted to finalize assignments – not dwell on learning, etc. What triggered us to think that things might be different this time around was the fact that so many in our survey population already keep process-portfolios in the form of 'quantified self activities' (Endomondo etc.).

It seems like the student's success using technology in the learning process came from within. It wasn't brought on by clever didactic designs or massive it-investments. It was brought on by a well-developed technological literacy which in turn just makes it much more difficult to work with for us as educators.

The two other students did gain from applying the principles to their learning process but not enough for them to continue doing it after the experiment ended. It seems as if the students strive for immediate gratification from their study techniques and that they feel that keeping a learning process portfolio on their smartphone is inconvenient. It seems as if the students are not directly interested in learning to master their own learning process, they are more focused on receiving knowledge from 'traditional' teaching.

## **6.0 Findings and conclusion**

We did not find the connection between extracurricular 'quantified self' activities and learning tracking we were looking for. But it became quite clear that those who used their smartphone to create consciousness of their own learning gained a more focused approach to studying.

We also found that it is more complex to raise consciousness of learning than of exercise, nutrition, sleep, mood, web activity, etc. We assumed that a learning process would be difficult to quantify due to learning's personal and qualitative nature. Normally, we only quantify the summative culmination of learning in exams and tests. A learning process could also be quantified in number of pages (book and web) read, links shared, tweets, re-posts on Digg, hours spent, etc. That type of quantification would be, technically, easier to do, but it would give the impression that the number of inputs would be a measure of success in itself and not the individual processes of learning. This study's aim was to

investigate how a smartphone could be used to generate individual consciousness of own learning process and if the individual quantification could be turned into a more collaborative process. We called the collaborative process 'open source learning stream' because it is a co-created learning process where all those who contribute to the stream will learn something different. The next step is to investigate whether that consciousness could be a contributing factor to gain more robust study skills in general so that learners could be on route towards 'the self-programmable student' (Castells 2005). So we end up where we began, with the quote from Wenger suggesting that something fruitful would happen if we '*placed learning in the context of our lived experience of participation in the world?*' (Wenger 1999). It might need some building up, but we are certain that a qualification of the quantified self in a learning context will potentially utilize technology better and maybe catalyze a more conscious learning process.

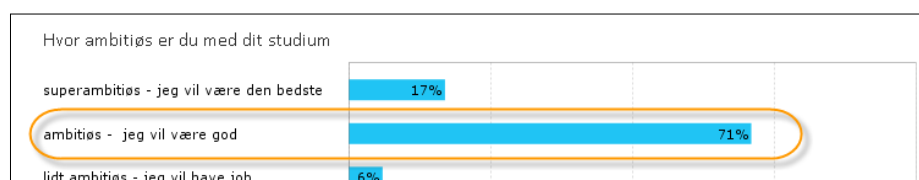
We also learned that learning in a designed rhizomatic network (the Twitter experiment), information-sharing and knowledge building take on a new form. So, to answer the question: 'How can smartphones be utilized as vehicle for conscious competence learning?' The answer is; by making all the circumstances right.

The circumstances that we found to be important are:

- Well defined positions in the pedagogical design
- Well defined structures and mechanisms – organization, tools and roles in learning activities
- That the students understand and accept the positions and structures
- That the curriculum, activities and subject are suitable for this type of learning process
- That the students have reflective competencies

If these circumstances are right, the smartphone can be used to create a more conscious and more focused learning process. The difficult part is that the circumstances are partly up to the student because the circumstances belong to his/her PLE.

The studies in this paper will serve as pre-study to a larger study. Now we know some of the pitfalls and we know that we have to clarify and maybe train the positions in the classroom in order for network learning to work. We have learned that even though the students claim to be ambitious (88%):



**Figure 4:** Question: How ambitious are you?

They also expect to be lead from information to knowledge. So the idea that students should be responsible for their own learning process is not a natural conceptualization for our students. It looks as if teaching is thought of as a concrete commodity and in itself the goal. So, being ambitious, in this context, means to follow teaching. When this study is carried out on a larger scale, we will try to overcome this by introducing some of the principles of PEEL (project for enhancing efficient learning). In PEEL (Mitchell 2009), the researchers present ideas as to how the didactic design can scaffold the learners to be self-programmable (Castells 2005). We still believe that it is worth investigating how the quantified self, technology and technological literacy can take learning to another level.



## References:

- Achinstein, Peter (1991) *Particles and Waves: Historical Essays in the Philosophy of Science*, Oxford University Press
- Bay, Morten (2009) *Homo Conexus*, Gyldendal Business
- Bhaskar, Roy. (1979) *The possibility of naturalism*. Brighton, UK: Harvester.
- Bhaskar, Roy (2008) *A Theory of Realist Science*, Verso
- Burch, Noel (1970) *The Four Stages for Learning Any New Skill*. Gordon Training International, CA
- Carr, Nicholas (2010) *The Shallows: What the Internet Is Doing to Our Brains* W. W. Norton & Company; Reprint edition
- Castells, Manuel and Cardoso, Gustavo, eds.( 2005) *The Network Society: From Knowledge to Policy*. Washington, DC: Johns Hopkins Center for Transatlantic Relations,
- Deleuze, Gille; Guattri, felix (1987) *A Thousand Plateaus – capitalism and schizophrenia*, University of Minnesota Press
- Fallows, James (2006) *Homo Conexus Technology Review on Web 2.0*, The Atlantic july/august 2006
- Feritas de, Elisabeth (2012) *The Classroom as a Rhizome*, SAGE 2012
- Gee, James Paul (2013) *The Anti-education Era*, Palgrave Macmillan
- Kagan, Spencer (2009) *Kooperative Learning*, Kagan Cooperative Learning; 2nd edition
- Kay, Robert (2003) *Facilitating Authentic Learning in the Virtual Space: An autopoietic view*. ITHET'03KMD analyse (2012) [Folkeskolens digitale tilstand](#):
- Kjærgaard, T., Sorensen, E.K. 2014: *Rhizomatic, digital habitat - A study of connected learning and technology application*, Paper submission ICEL 2014
- Larsen, Marlene Charlotte (2009) *Young Danes Online : Understanding the Impact of Online Social Networking on Friendship and Identity*, Icfai University Press
- Luhmann, Niklas (1995) *Social Systems*, Stanford: Stanford University Press,
- Mitchell, Ed (2009) *Teaching for effective learning: The complete book of PEEL teaching procedures*. Peel Publications, Australia
- Negroponte, Nicholas (1995). *Being Digital*. New York: Vintage Books.
- Rheingold, Howard (2012) *Net Smart – how to thrive online*, The MIT Press
- Simens, George (2005) *Connectivism – A learning theory for the digital age*, elearningspace
- Sayer, A. (1992). *Method in social science: a realist approach*, (2nd ed.)London: Routledge.
- Sorensen, E. K. (2010), *Theory-Informed Design of Networked Teaching and Learning: Focusing on Facilitation of Democratic Dialogue*. Proceedings of the European Conference for Open and Distance E-Learning, EDEN 2011
- Stephenson, Karen (1997) *What Knowledge Tears Apart, Networks Make Whole*, Internal Communication Focus, no. 36
- Walker, Lyndon *Twitter Learning Analytics in R* Swinburne University of Technology
- Wenger, White Smith (2009) *Digital Habitat*, CPsquare
- Wenger, Etienne (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.
- Wikgren, Marianne (2004) *Critical realism as a philosophy and social theory in information science?* Åbo Akademi University Library, Åbo, Finland